# THE POSTNATAL DEVELOPMENT OF WOOL FOLLICLES, SHEDDING, AND SKIN THICKNESS IN INBRED MERINO AND SOUTHDOWN–MERINO CROSSBRED SHEEP

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*Summary*

A quantitative study has been made of the postnatal development of the follicle population, the incidence of shed follicles, and changes in skin thickness in four Merinos and four Southdown–Merino crossbreds. The animals were sampled on 30 occasions from birth to approximately 2 years.

In addition to the two main types of follicles—primary (*P*) and secondary (*S*)—a third type, termed primo-secondary (*PS*) follicles, has been recognized. These follicles are usually situated on the ectal margin of the follicle group and possess associated sweat glands; arrector pili muscles are seldom present.

Most of the immature follicles (*Si*) seen in birth and early postnatal samples were derived secondaries (*SD*). As these follicles arise by branching, either from the original secondary (*SO*) follicle or from other derived secondary follicles, it is usually impossible to include all of them in counts made at only one level in the skin.

In general the $S/(P+PS)$ follicle ratios obtained for the early samples (birth to 60 days) were similar to or lower than they were for later samples.

In both the Merinos and crossbreds the incidence of shed follicles was extremely low. In the Merinos, shed follicles varied from a maximum of 1·4% in one animal at 631 days to 8·5% in another animal at the same age. In the crossbreds, shed follicles varied from 1·1% in an animal at 445 days to 12·1% in an animal at 277 days. No marked influence of season on the incidence of shed follicles was discernible.

There was no trend of skin thickness with age except during the early postnatal period when most sheep showed a slight upward trend. Other factors which appeared to influence the thickness were nutrition, pregnancy, and shearing. The skin was thicker in the crossbreds than in the Merinos.

## I. INTRODUCTION

Although the general features of the development and growth of wool follicles are now well established, little attention has been given to the detailed histological changes in follicles that take place from birth to adulthood. Such studies are important for a better understanding of the adult fleece and the control of wool growth.

This paper is an account of the postnatal development of the follicle population, the incidence of shed follicles, and age and seasonal changes in skin thickness in four Merino and four Southdown–Merino crossbred sheep. These quantitative

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observations formed part of detailed histological studies of the formation of bundles of primary and secondary follicles, to be described in a subsequent paper.

## II. Material and Methods

### (*a*) *Animals*

Four inbred Merinos (2 ewes and 2 wethers), born 7–10.x.56, and four Southdown–Merino crossbreds (3 ewes and 1 wether), born 29.ix.56–1.x.56, were used for this study. All the sheep were born and reared in the field at the C.S.I.R.O. McMaster Field Station, Liverpool, N.S.W. Each animal was weighed at weekly or fortnightly intervals from birth to approximately 2 months, and at irregular intervals thereafter. All animals were shorn at about 130, 305, and 675 days. Three of the ewes lambed twice and the remainder once during the experimental period. Four of them first became pregnant at 216–229 days, with subsequent lambing and lactation.

### (*b*) *Skin Sampling and Histological Methods*

On 30 occasions from birth to approximately 2 years, two skin samples were taken with a 1-cm trephine from the mid-lateral region of the trunk of each sheep. The samples were taken from one side of the trunk up to sample 15 when sampling of the other side was commenced and continued to sample 30. Samples 15, 18, and 30 were taken from both sides of the body.

The mean ages at the second and later sampling were as follows: Southdown–Merinos—17, 31, 45, 66, 87, and 108 days, and at 28-day intervals to 752 days. Merinos—8, 22, 36, 57, 78, and 99 days, and at 28-day intervals to 743 days. One Merino died after the 28th sampling.

All the skin samples were fixed in 5% formol saline. One of the duplicate samples taken on 19 different occasions (Nos. 1–5, 7, 9, 11, 13, 15 (both sides), 16, 18 (both sides), 19, 21, 23, 25, 26, 28, and 30 (both sides)) were serial-sectioned at 8 $\mu$ parallel to the skin surface, and from the skin surface to the lower sebaceous gland level. A few of the remaining samples, taken on the same occasions, were serial-sectioned at 8 and 15 $\mu$ at right angles to the skin surface. Staining was with haemalum, eosin, and picric acid.

### (*c*) *Skin and Follicle Measurements*

(i) *Macroscopic.*—The thickness of at least one of the skin samples (excluding the *panniculus carnosus*) was measured after fixation with an instrument (Wodzicka 1958*a*) which exerted a constant pressure of 50 g/cm$^2$. The wool on each sample was closely clipped.

(ii) *Microscopic.*—Using a microprojector and a magnification of $\times$215, counts of the follicle and fibre density on transverse sections of skin (i.e. sections parallel to the skin surface) at the mid-sebaceous gland level were made on six circular fields of 1 mm$^2$. The counts were corrected for shrinkage in a manner similar to that described by Carter and Clarke (1957). A small spot of Indian ink was placed on the coverslip above the section selected for counting. This spot was then used

as a "landmark". By this technique every field was relocated easily for re-examination and for more detailed observations with a research microscope.

### (*d*) *Terminology*

The terminology of Hardy and Lyne (1956*a*) is used with the addition of primo-secondary (*PS*) follicles. These follicles, usually situated near the ectal margin of the follicle group, have sweat glands which are smaller than those of primary (*P*)

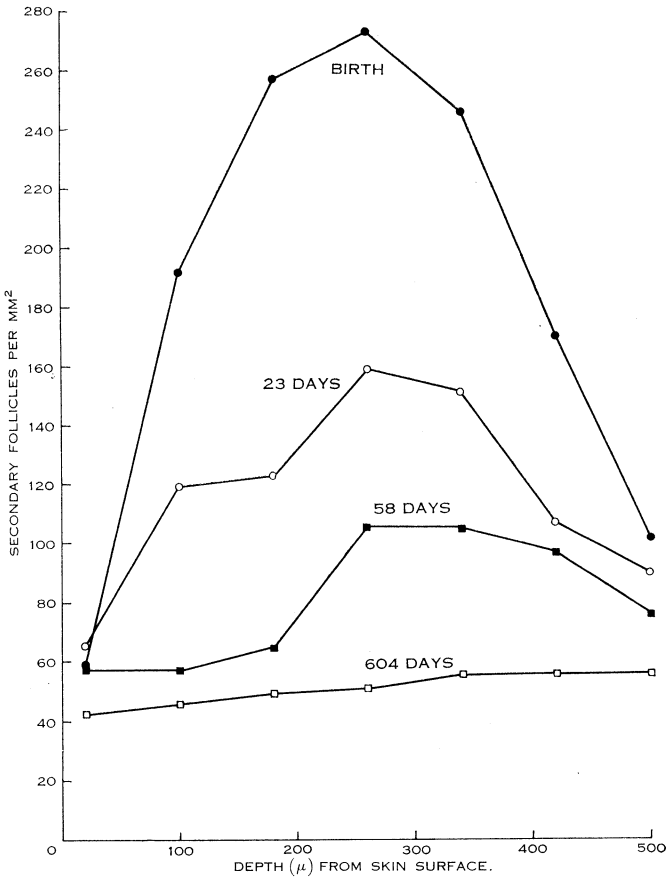


Fig. 1.—Relation between number of *S* follicles per mm² and depth from the skin surface in four skin samples from one inbred Merino (K293). Each point is the mean of counts of four 1-mm² fields.

follicles, and are intermediate in size between *P* and secondary (*S*) follicles. Arrector pili muscles are seldom present. *PS* follicles have been included with *P* follicles except where otherwise indicated. Follicles belonging to bundles of apparent *P* follicles with a single associated sweat gland (Lyne 1957) were also included in the primary follicle count.

The suffix *e* to follicle type symbols denotes a *dormant* follicle which has lost its fibre.

## III. The Development of the Follicle Population

### (a) *Relation between Apparent Number of Secondary Follicles per Unit Area and Depth*

To determine the level in the skin at which there is a maximum density of immature secondary (*Si*) follicles, the number of follicles in serial sections of samples, taken at birth, 23, 58, and 604 days, from one sheep, were counted. The sample taken at 604 days was included for comparison but did not contain immature follicles.

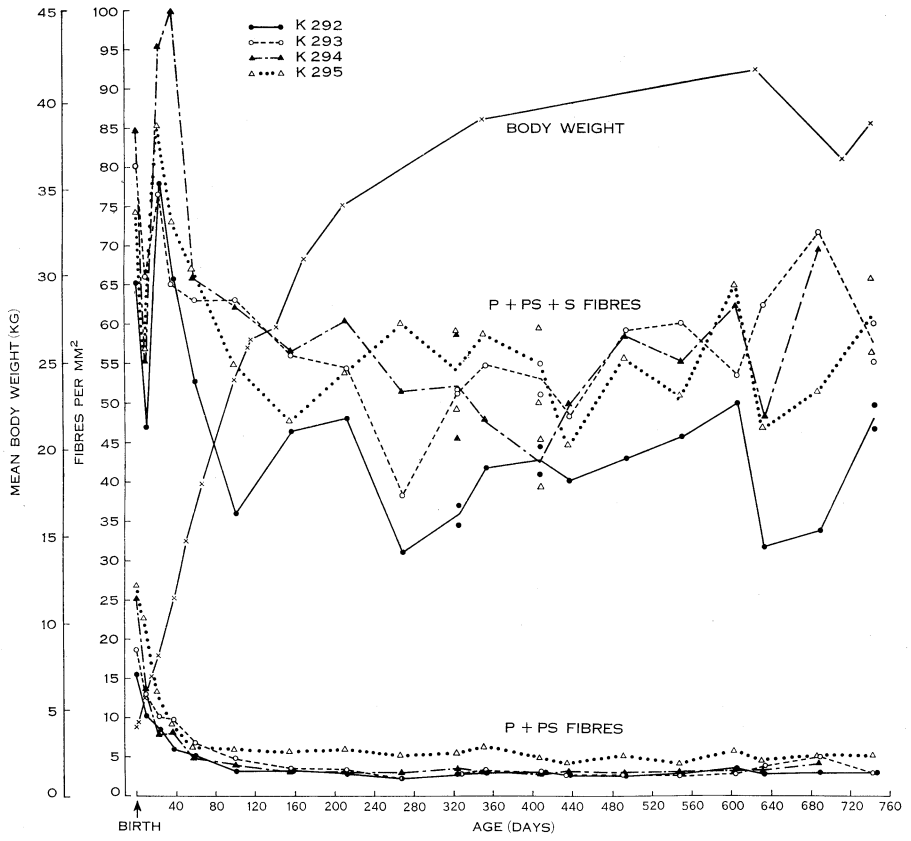


Fig. 2.—Relation between age, mean body weight, and fibre density in four inbred Merinos. Where counts were made on samples from both sides of the body, the lines are drawn midway between the values.

These counts showed that at each age the maximum density was reached at about the same depth (250–300 $\mu$ from the skin surface) but that the peak of density was much sharper at birth than it was at 23 or 58 days (Fig. 1). Therefore, the depth of counting immature follicles in the new-born lamb must be selected with much greater care than when dealing with older material. The level showing the maximum density of follicles was close to the mid-sebaceous gland level at which all the other measurements were made.

### (*b*) *Primary and Secondary Follicles and Fibres per Unit Area*

The changes in the fibre population density (number of $P+S$ fibres per mm$^2$) for each sheep during the postnatal period studied are shown in Figures 2 and 3. The density of the $P$ fibres for each sheep is also shown in these figures.

In the Merinos (Fig. 2) the decrease in $P+S$ fibre density during the first week after birth was followed by a rapid rise and fall. This feature was not seen in the crossbreds (Fig. 3), probably due to the longer interval between the first and

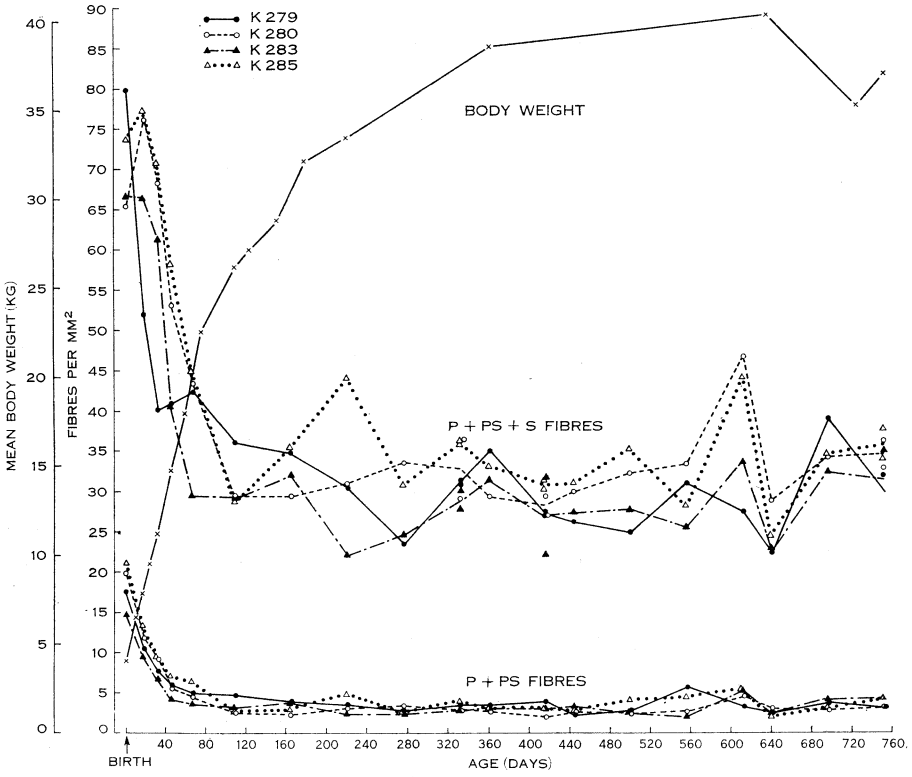


Fig. 3.—Relation between age, mean body weight, and fibre density in four Southdown–Merinos. Where counts were made on samples from both sides of the body, the lines are drawn midway between the values.

second sampling. After 3–4 months the density of each genotype remained fairly constant up to 2 years of age.

Comparison of Figures 2, 3, and 4 shows that the Merinos had a higher follicle and fibre density than the crossbreds. The only exception was the second sample in which the crossbreds had a higher fibre density than the Merinos (Fig. 4).

Although the mean fibre population densities of the two genotypes were similar at birth (about 75 per mm$^2$ for the Merinos and 71 per mm$^2$ for the crossbreds) they were distinctly different after all the follicles had matured, mainly because the densities in the crossbreds decreased by more than 100% and in the Merinos by only about 50%.

The follicle population density (Fig. 4) decreased rapidly during the first 3–4 months. For the Merinos the mean number of $P+S$ follicles at birth was about 290 per mm$^2$ compared with about 180 per mm$^2$ for the crossbreds. By 110 days in the crossbreds and 155 days in the Merinos most of the $S$ follicles had matured, hence the fibre and follicle densities became almost equal. At all ages the follicle density for the Merinos was above that for the crossbreds. Considering only samples taken after 5 months of age, the mean follicle density for the Merinos is 51·8 per mm$^2$, and for the crossbreds it is 31·5 per mm$^2$. For individual animals, the means and standard deviations for the same period are shown in Table 1.

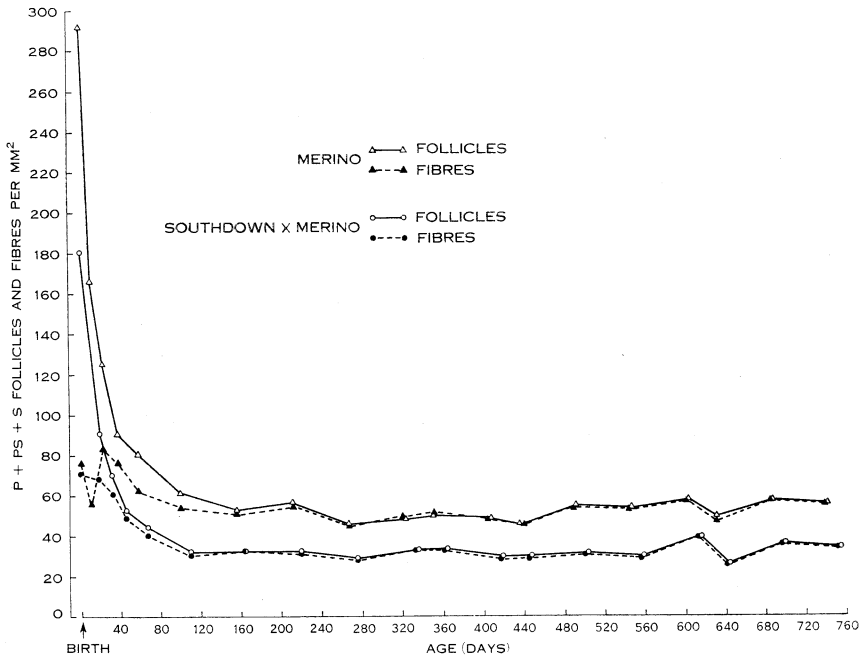


Fig. 4.—Relation between age and mean follicle and fibre density in four inbred Merinos and four Southdown–Merinos.

All the $P$ follicles had matured (i.e. they contained a keratinized fibre) at birth. $P$ follicle density, similar in the two genotypes at birth, also decreased rapidly during the early postnatal period (Figs. 2 and 3). The apparently higher density of $P$ follicles in one Merino was due to a high proportion of $PS$ follicles.

### (c) *Secondary/Primary Follicle and Fibre Ratios*

The $S/P$ follicle ratios for each sheep during the postnatal period studied are shown in Figures 5 and 6. In general, the follicle ratios obtained for the early samples (birth to 2 months) are similar to or lower than they are for later samples. In the Merinos the mean follicle ratios obtained for the first five samples compared with the last five samples (Table 1) show an increase of from 13·2 to 35·9%. The actual number of $S$ follicles in the early samples must be higher than the results

obtained because the counting was done at only one level. In contrast to the Merinos, only one of the crossbreds shows a large increase (29%) in the mean follicle ratio when these two periods are compared. Of the remainder, two show no change and one shows a small decrease (7·4%).

The $S/(P+PS)$ follicle ratios were generally higher in the Merinos than in the crossbreds (Table 1). The one exceptionally low ratio in the Merinos was due to the high proportion of $PS$ follicles.

TABLE 1

COMPARISON OF THE $S/(P+PS)$ FOLLICLE RATIOS AND $P+PS+S$ FOLLICLE DENSITIES IN FOUR INBRED MERINOS AND FOUR SOUTHDOWN–MERINO CROSSBREDS

| Genotype | Sheep No. and Sex | $S/(P+PS)$ Follicle Ratios | | | | | | $P+PS+S$ Density | |
|---|---|---|---|---|---|---|---|---|---|
| | | First 5 Samples Examined (birth–2 months) | | Last 5 Samples Examined (17–24 months) | | Last 13 Samples Examined (5–24 months) | | Last 13 Samples Examined (5–24 months) | |
| | | Range | Mean | Range | Mean | Mean | S.D. | Mean | S.D. |
| Inbred Merino | K292♂* | 8·5–12·8 | 11·1 | 10·4–15·0 | 12·7 | 13·3 | ±1·82 | 41·8 | ±6·3 |
| | K293♂* | 8·5–14·6 | 13·1 | 13·2–22·2 | 17·8 | 17·2 | ±2·14 | 55·6 | ±6·9 |
| | K294♀ | 11·6–15·3 | 13·3 | 13·8–18·6 | 16·4 | 15·8 | ±1·76 | 53·5 | ±8·2 |
| | K295♀ | 7·6–10·4 | 9·1 | 8·9–12·1 | 10·3 | 9·8 | ±1·02 | 56·0 | ±6·1 |
| Southdown–Merino | K279♀ | 6·1–8·9 | 7·6 | 4·5– 9·1 | 7·5 | 7·6 | ±1·33 | 30·0 | ±4·3 |
| | K280♀ | 6·0–9·0 | 7·9 | 8·7–11·9 | 10·2 | 10·4 | ±1·12 | 32·8 | ±4·7 |
| | K283♀ | 7·1–9·3 | 8·1 | 4·7–11·8 | 7·5 | 8·0 | ±1·72 | 28·8 | ±4·2 |
| | K285♂* | 7·0–9·6 | 8·0 | 5·3–10·9 | 8·1 | 8·7 | ±1·58 | 34·4 | ±5·1 |

*Wethers

Special attention was given also to the follicle ratios in one of the crossbreds (K285) which had a high frequency of $PS$ follicles (Fig. 7). In samples taken after 5 months of age the mean $S/(P+PS)$ ratio is $8·7 \pm 1·6$, whereas the mean $(S+PS)/P$ ratio is $10·3 \pm 2·0$.

At birth the mean $S/P$ fibre ratios in the two genotypes were very similar; 2·7 for the Merinos and 3·0 for the crossbreds. Figure 8 shows the percentage of mature $S$ follicles in each sheep from birth to about 1 year. The difference in the percentage of mature $S$ follicles in the two genotypes at birth (17–25% for the Merinos; 25–44% for the crossbreds) was apparently due to the fact that a higher percentage of $SD$ follicles occurs in the Merinos. In both genotypes the maximum rate of $S$ follicle maturation was between birth and 1 month, and this is in agreement with the observations of Schinckel (1955*a*) and Short (1955*b*) for other Merinos and Merino crossbreds. The follicle population as a whole appeared to mature earlier in the crossbreds than in the Merinos.

Pregnancy and lactation doubtless added to the variability of the mature follicle ratios and densities. These effects, however, were subsequent to the phases of the development of the follicle population considered here.

## IV. Shedding

The number of *dormant* follicles which had shed and released their fibres was also counted in each of the six 1-mm² fields. As shedding was sometimes localized

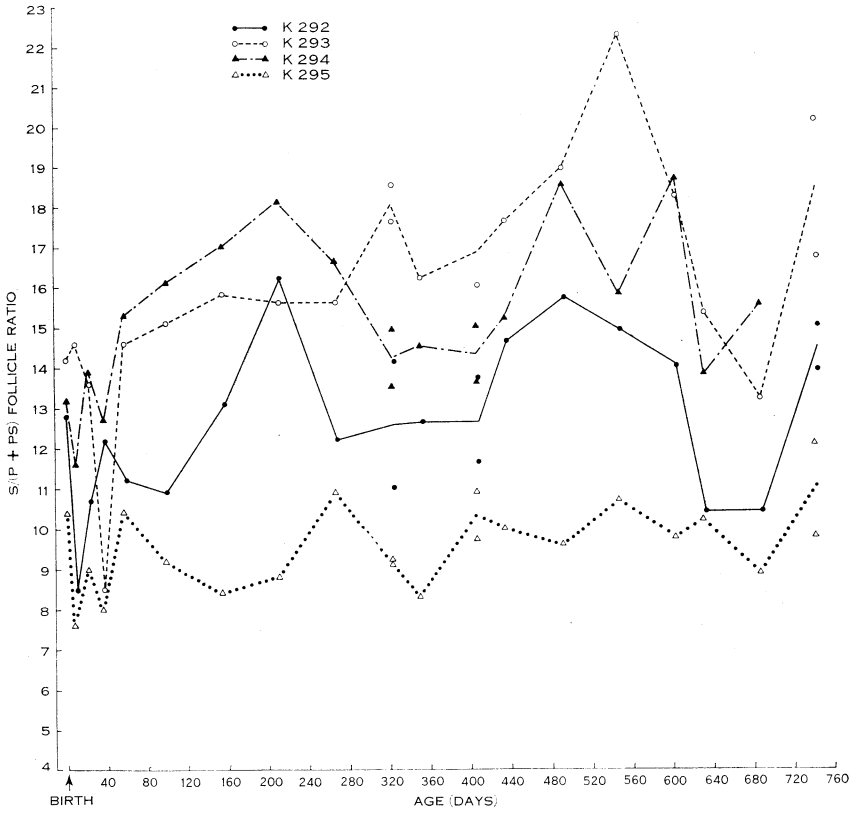


Fig. 5.—Relation between age and $S/(P+PS)$ follicle ratio in four inbred Merinos. The low ratio in one animal is due to the high frequency of *PS* follicles. Where counts were made on samples from both sides of the body, the lines are drawn midway between the values.

these counts did not always give a satisfactory estimate of the abundance of the shed follicles in the whole trephined sample. Because of this the *approximate* number of shed follicles over the whole sample was counted and scored as follows: 0 = no shed follicles; 1 = 1–5 shed follicles—very little shedding; 2 = 6–15 shed follicles—little shedding; 3 = 16–25 shed follicles—some shedding; 4 = >25 shed follicles—shedding common.

### (a) *Relation between Follicle Type and Shedding*

Tables 2 and 3 summarize the observations and it is clear that the incidence of shed $P$ and $S$ follicles was extremely low; in fact, for all practical purposes shedding was negligible.

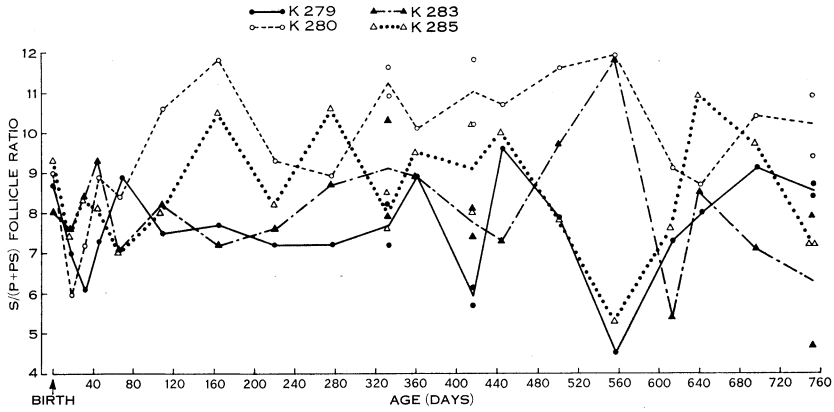


Fig. 6.—Relation between age and $S/(P+PS)$ follicle ratio in four Southdown–Merinos. Where counts were made on samples from both sides of the body, the lines are drawn midway between the values.

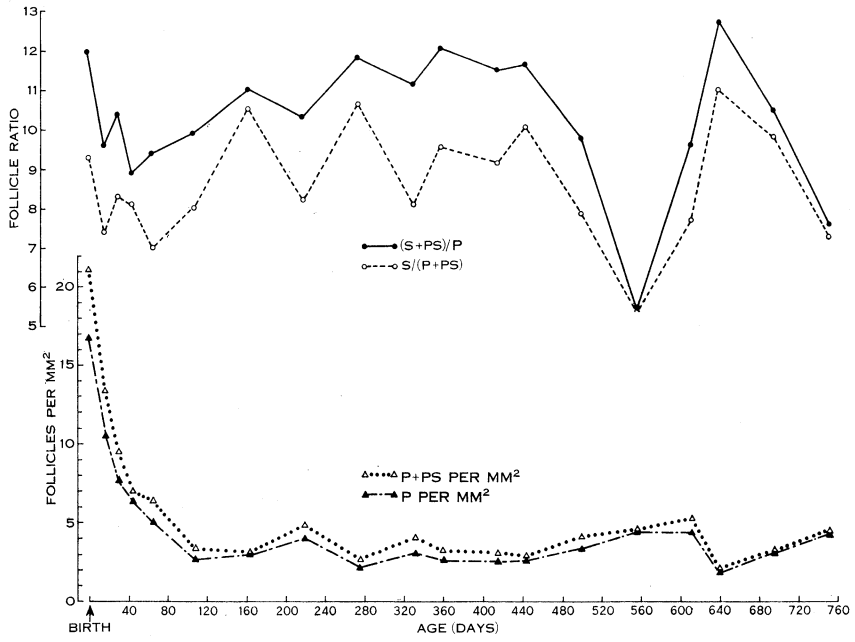


Fig. 7.—Relation between age, follicle ratios $S/(P+PS)$ and $(S+PS)/P$, and density of primary follicles ($P$ and $P+PS$) in one Southdown–Merino (K285).

In the Merinos (Table 2) there were little, if any, differences between the percentage of shed $P$ and $S$ follicles. It is interesting to note that in one sheep there

were no *Pe* or *PSe* follicles in a total of 981 examined. There were, however, a few shed primary follicles outside the fields examined.

In the crossbreds (Table 3) *Se* follicles were fewer than *Pe* follicles.

### (*b*) *Relation between Age, Season, and Shedding*

The percentage of shed follicles (*Pe*+*PSe*+*Se*) in each sample has been plotted against age (Fig. 9) to reveal possible age or seasonal trends in the frequency of shedding.

In general, the proportion of shed follicles increased with age. While all samples taken from birth to about 160 days exhibited less than 1·5% of shed follicles, in

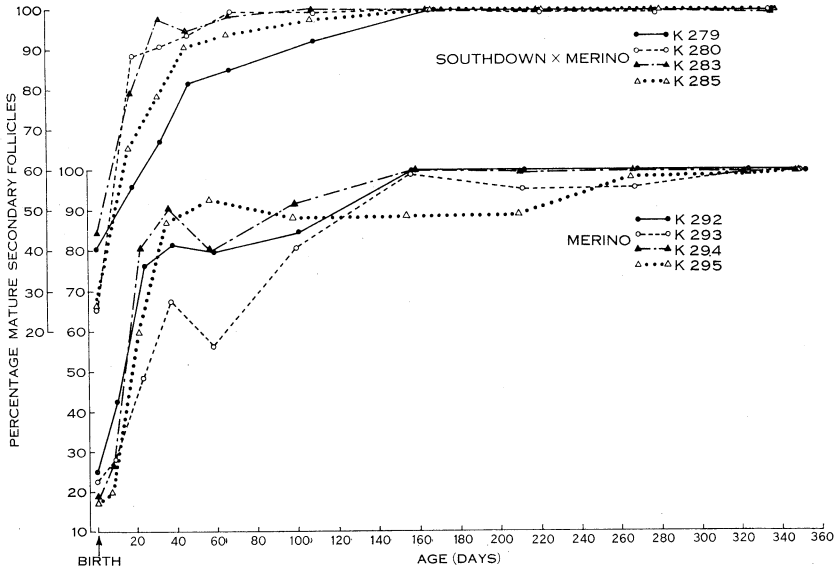


Fig. 8.—Percentage of mature *S* follicles in four inbred Merinos and four Southdown–Merinos from birth to 1 year.

the Merinos the maximum percentage of shed follicles was only 1·4% in one animal at 631 days and 8·5% in another at 630 days. Amongst the crossbreds shed follicles varied between a maximum of 1·1% for one animal at 445 days to 12·1% for another at 277 days.

No marked influence of season on the incidence of dormant follicles without fibres was discernible.

The shedding score, being based on an examination of the whole sample, is probably a better indication of the true frequency of shed follicles than the percentages which referred only to the particular six fields examined. There appeared to be a trough, both in percentage and shedding score, in the late spring–early summer for the Merinos at the beginning of their second year (Fig. 9), but the data were not extensive enough to confirm or confute this in a later year.

## V. Changes in Skin Thickness

The changes in mean skin thickness for each genotype are shown in Figure 10. The mean skin thickness of the crossbreds was always higher than that of the Merinos,

Table 2

SUMMARY OF OBSERVATIONS ON FIBRE SHEDDING IN FOUR INBRED MERINOS

| Sheep No. | Age Period Examined | Total No. of $P+PS$ Follicles Examined | $Pe+PSe$ Follicles* | | Total No. of $S$ Follicles Examined | $Se$ Follicles* | |
|---|---|---|---|---|---|---|---|
| | | | No. | % of Total $P+PS$ | | No. | % of Total $S$ |
| K292 | Birth–745 days | 826 | 9 | 1·09 | 10,075 | 63 | 0·59 |
| K293 | Birth–744 days | 963 | 5 | 0·52 | 14,404 | 38 | 0·26 |
| K294 | Birth–687 days | 981 | 0 | 0 | 14,127 | 29 | 0·21 |
| K295 | Birth–742 days | 1452 | 9 | 0·62 | 13,648 | 115 | 0·84 |
| Total | | 4222 | 23 | 0·54 | 52,254 | 242 | 0·46 |

* Dormant follicles which have released their fibres.

except during the first winter (age 240–300 days) when they were very similar. The mean skin thickness for the Merino samples was 1·83 mm and for the crossbred

Table 3

SUMMARY OF OBSERVATIONS ON FIBRE SHEDDING IN FOUR SOUTHDOWN–MERINO CROSSBREDS

| Sheep No. | Age Period Examined | Total No. of $P+PS$ Follicles Examined | $Pe+PSe$ Follicles* | | Total No. of $S$ Follicles Examined | $Se$ Follicles* | |
|---|---|---|---|---|---|---|---|
| | | | No. | % of Total $P+PS$ | | No. | % of Total $S$ |
| K279 | Birth–753 days | 982 | 15 | 1·53 | 7,436 | 67 | 0·90 |
| K280 | Birth–753 days | 925 | 7 | 0·76 | 8,538 | 25 | 0·29 |
| K283 | Birth–752 days | 837 | 6 | 0·72 | 6,597 | 40 | 0·61 |
| K285 | Birth–751 days | 1071 | 5 | 0·47 | 8,932 | 23 | 0·26 |
| Total | | 3815 | 33 | 0·87 | 31,502 | 155 | 0·49 |

* Dormant follicles which have released their fibres.

samples was 2·15 mm. There were no marked changes with age, but during the early postnatal period most sheep showed a slight upward trend; other factors appar-

ently influencing skin thickness were nutrition, pregnancy, and shearing. The decrease observed during both autumn–winter periods was probably due to inanition (Wodzicka 1958*b*; Lyne, unpublished observations). This effect, however, was

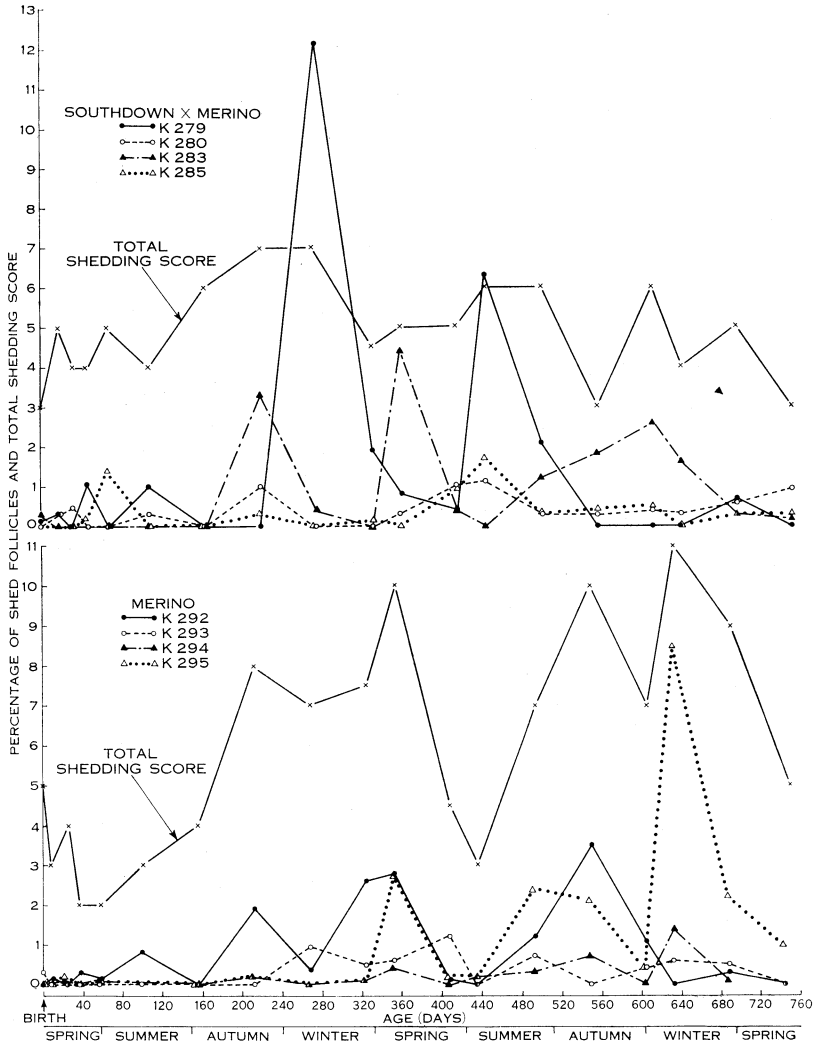


Fig. 9.—Relation between age, season, and percentage of shed follicles in four inbred Merinos and four Southdown–Merinos. The total shedding score (summation of the shedding scores of the four sheep of each group) is also shown.

probably complicated by pregnancy (Fig. 10), which also could have affected skin thickness. The skin increased in thickness immediately after each of the two winter shearings, thus confirming the observations of Wodzicka (1958*c*). The slight increase in thickness after the summer shearing is also in line with observations by Wodzicka-Tomaszewska (1960) that skin increases in thickness as a result of cold stress.

## VI. Discussion

### (*a*) *Follicle Population*

A number of authors have made observations on the postnatal development of the follicle population in various breeds. The data on the density of the *P* follicles and fibres are in agreement with the observations of Schinckel (1955*a*), Carter and Tibbits (1959), and others. All the *P* follicles are mature at birth and the decrease in number per unit area during postnatal life is the result of skin expansion.

In observations on the density of mature *S* follicles in South Australian Merinos, Schinckel (1955*a*) describes a "small rise during the first week followed by an extremely large increase in the second and a small rise to a maximum level during the third week. Thereafter, the density falls."

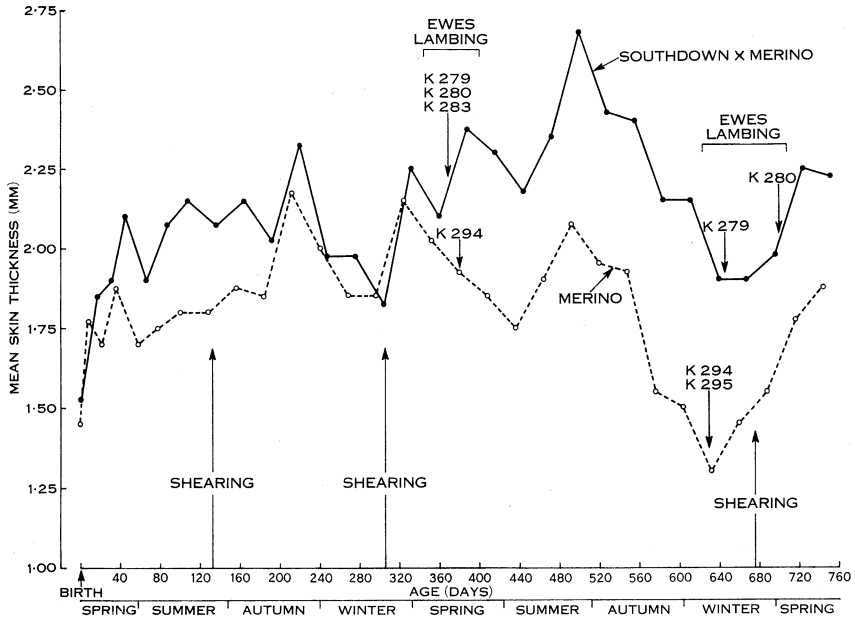


Fig. 10.—Relation between age and mean skin thickness in four inbred Merinos and four Southdown–Merinos.

In the four Merinos examined in the present study the mature *S* density, as well as the mature *P*+*S* density, decreased during the first week after birth. Thereafter, the density rose to a peak at about 25–35 days and then fell rapidly. In contrast to the Merinos, three out of the four crossbreds did not show a fall in the mature *S* density at the second sampling but this was probably due to the fact that these animals were about 9 days older than the Merinos when this sample was taken. One of the crossbreds showed an immediate postnatal fall in the mature *S* density but this was not followed by a rise similar to that seen in the Merinos. As pointed out by Schinckel (1955*a*), changes in the density of the mature *S* follicles are the net result of the interaction of rate of maturation of *S* follicles and the rate of skin expansion accompanying growth. Nutrition has an important influence on the rate

of maturation of the *S* follicle population (Schinckel 1955*b*; Short 1955*a*). Ferguson *et al.* (1956) have also demonstrated the important influence of the thyroid gland.

The follicle population as a whole matured by 110 days in the crossbreds and by 155 days in the inbred Merinos. This confirmed observations on other Merinos and Merino crossbreds (Fraser 1954; Schinckel 1953, 1955*a*; Short 1955*b*).

The increase in the observed number of *S* follicles per *P* follicle in postnatal life in the inbred Merinos is similar to the increase found by Carter and Tibbits (1959) for New Zealand Romney and *N*-type sheep. As pointed out by Carter and Tibbits, apparent delay in *S* follicle initiation may, however, be due to the difficulty of observing all very immature follicles in early postnatal samples. Amongst medium-wool (Peppin) Merinos and Merino crossbreds (Short 1955*b*) and strong-wool (South Australian) Merinos (Schinckel 1955*b*) the *S*/*P* follicle ratio at birth was greater than the mature *S*/*P* fibre ratio (up to 6 months of age for the medium-wool Merinos and up to 15 months for the strong-wool Merinos). Both Short and Schinckel claimed that some *S* follicles may not mature if the animal experiences an adverse early postnatal environment.

In various British breeds examined by Burns (1953, 1954, 1955) and Ryder (1957) there was an apparent increase of 1·0 in the *S*/*P* follicle ratio between birth and maturity. These latter authors claimed that this ratio increase was significant and that it was evidence that follicles were initiated after birth. There does not appear to be any other way of explaining such increases in *S*/*P* ratio in these British breeds, except that it was not established in the observations of Burns and Ryder that they succeeded in counting all the *Si* follicles in the birth samples; or even that they were aware of the aforementioned difficulties. In Merino and Merino crossbreds most of the immature follicles seen in birth and early postnatal samples are derived secondaries. As these follicles arise by branching, either from the *SO* follicle or from *SD* follicles (Hardy and Lyne 1956*b*), it is virtually impossible to observe all of them at one level in the skin. Consequently, it is important to use sections at the optimal level for counting. Short (1955*b*) has already drawn attention to the importance of the depth of counting of immature follicles if large discrepancies are to be avoided. The level which shows the maximum number of *Si* follicles must be more critical in Merinos than in all other breeds because of the greater frequency of follicle branching. There is no evidence that counts, even at such an optimal level, will include *all* the *SD* follicles in early postnatal samples, and it is most likely that increases in *S*/*P* ratio, e.g. the increases observed in the inbred Merinos after birth, may have been due to a low count in the early postnatal samples, even though the level of apparent maximum density was selected.

Although several authors (Burns 1949; Narayan 1960) have referred to occasional follicles similar to the primo-secondaries described here, no quantitative observations on these follicles are available. Both Burns and Narayan classified these follicles as primaries despite their aberrant position. The present study supports the view of Burns that follicles form a continuous series in development, and that the usual criteria for distinction between *P* and *S* follicles cannot always be readily observed. If one considers that only *P* follicles develop sweat glands, then the *PS* follicles must be included with the primaries, and it is clear, for example from the

data given here (Fig. 7), that the $(S+PS)/P$ ratio can be substantially higher than the $S/(P+PS)$ ratio.

### (*b*) *Shedding*

The literature on follicle shedding in sheep is not extensive (see Fraser and Short 1960) and there is apparently no information of a quantitative nature available on this aspect for Merino sheep. In the Merino lamb, Carter (1939) states that the *P* follicles are responsible for almost the entire population of birthcoat kemps (mother hair) which are gradually shed over a period of several months following birth, and then followed by true wool fibres; though in some individuals, and in some regions of the skin more than others, such birthcoat kemps may be succeeded by a second generation of coarse persistent hairy fibres.

Shedding was estimated in the present investigation from the number of dormant follicles without a fibre, though the number found cannot be related, as yet, to any particular period of time, because it is not known how long a follicle might retain a club hair or remain dormant before growing another fibre. The period of time might well depend upon an interaction of fleece-type and follicle type. Very few regenerating follicles were observed at any age which suggests that follicle regeneration is rapid.

There appeared to be no increase in the number of shed follicles at the time of shedding of the birthcoat fibres (2–3 months of age) as noted in other breeds (Fraser, Ross, and Wright 1954; Ross and Wright 1954); in fact rather the reverse (Fig. 9). The published observations, however, refer only to fibres released from follicles whereas the present observations refer only to dormant follicles without their fibres. The number of shed follicles observed during the apparent phase of birthcoat fibre shedding could be small, or could be related to the method of estimation. For instance, the time of dormancy after shedding of birthcoat fibres could be shorter than after shedding in later life. This would mean that relative to the true frequency of quiescent follicles (with or without club hairs) the number of follicles counted without a fibre would be lower in early than in later life. The presently available information is not sufficient to resolve this situation.

The very low incidence of shed follicles suggests that in both the inbred Merinos and Southdown–Merino crossbreds, follicles have a very long growing phase, and it is interesting to compare the incidence of shed follicles in these animals with that observed by the same method in some other breeds. In various British breeds (see Fraser and Short 1960) the proportion of shed follicles is higher than in the present material.

Clearly, further investigations of the possible cyclic activity of wool follicles now require a more critical approach, exploiting sequential sampling of both skin and fleece to cover age and seasonal trends, with comparisons of divergent fleece-types and adequate control of nutritional and physiological status.

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